

Experimental investigation on friction drilling of titanium alloy

ABSTRACT

Friction drilling is a green hole-making process that zealously utilizes the heat generated from the friction between the rotating conical tool and workpiece to create a bushing without generating chip. The difficult-to-machine materials with unique metallurgical properties have been developed to meet the demands of extreme applications. However, the major challenges of friction drilling on difficult-to-machine materials are the hole diameter accuracy, petal formation and tool wear. In this study, the effects of process parameters such as spindle speed and feed rate on bushing height and shape, hardness and tool wear in friction drilling of titanium alloy Ti-6Al-4V were experimentally investigated using tungsten carbide tool. Optical photographs have also been analyzed for better understanding of the chipless friction drilling process for different parametric settings. Experimental results indicated that the spindle speed has great influences for achieving better bushing formation and prolong the tool life. It was confirmed that the low spindle speed and low feed rate have great influences for achieving better bushing shape and height, prolong tool life and lower hardness that located adjacent to the hole wall. It also was discovered that the low thermal conductivity of Ti-6Al-4V caused to improper increment of frictional heat and surface temperature. This disadvantage leads to unsatisfactory bushing formation. This work demonstrated the performances of chipless friction drilling used on difficult-to-machine material that can offer a great prospective for a new product design and manufacturing.

Keyword: Friction drilling; Dry machining; Difficult-to-machine material; Titanium alloy; Tool wear